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TITLE: TERMINAL APPARATUS

INVENTOR: Yoshimasa UTSUMI

William S. Frommer
Registration No. 25,506
FROMMER LAWRENCE & HAUG LLP
745 Fifth Avenue
New York, New York 10151
Tel. (212) 588-0800

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an improper type of memory can entail inadequate recording or reproduction of data by the portable terminal apparatus.

Such inappropriate execution of recording or reproduction will lead to inadequate implementation of copyright protection.

In particular, the microphone input/line input-compatible terminal apparatus equipped with a copyright-noncompliant nonvolatile memory will pose a problem when a user completes a required billing process before downloading data over a network for recording purposes. In that case, the terminal apparatus inhibits data recording to the copyright-noncompliant nonvolatile memory while contents to be recorded are being distributed over the network. That is, the user cannot get the distributed contents recorded by operation of the apparatus, or leaves the apparatus to take care of the recording of downloaded data, only to find later that the recording has not been made. Once the user completes the billing process, the relevant contents are transmitted to the user from a server over the network without interruption. Although the user has already paid for the contents, the data cannot be recorded when transmitted continuously because of memory incompatibility.

[illegible]

In carrying out the invention and according to one aspect thereof, there is provided a terminal apparatus into which any one of a first and a second memory card is selectively inserted, the first memory card carrying a signal processing circuit for copyright protection, the second memory card not carrying a signal processing circuit for copyright protection, the terminal apparatus comprising: compression processing means for applying a second compression process to an input first compressed signal having undergone a first compression process, the second compression process being inferior to the first compression process in terms of compression efficiency; selecting means for selecting either the first compressed

second memory card not carrying a signal processing circuit for copyright protection, the terminal apparatus comprising: microphone inputting means for inputting an analog audio signal picked up by a microphone; converting means for converting a line input m-channel digital audio signal, m being an integer of at least 2, into an n-channel digital audio signal, n being a positive integer not greater than m; selecting means for selecting either the line input m-channel digital audio signal or the converted n-channel digital audio signal from the converting means; operating means for setting either a digital audio signal recording mode in which to record the line input m-channel digital audio signal, or an analog audio signal recording mode in which to record the analog audio signal input by the microphone inputting means; judging means for judging whether a memory card inserted into the terminal apparatus is the first memory card or the second memory card; controlling means for controlling the selecting means in accordance with a judgment made by the judging means and with the mode set by the operating means; and recording means for recording the audio signal selected by the controlling means to the inserted memory card.

Other objects, features and advantages of the

invention will become more apparent upon a reading of the following description and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a memory recording and reproducing apparatus applicable to the invention;

Fig. 2 is a block diagram of a copyright-compliant memory card applicable to the invention;

Fig. 3 is a block diagram of a copyright-noncompliant memory card applicable to the invention;

Fig. 4 is a block diagram of a memory recording and reproducing apparatus applicable to a first processing example of the invention;

Fig. 5 is a flowchart of steps constituting the first processing example performed when the copyright-compliant or copyright-noncompliant memory card is inserted into the memory recording and reproducing apparatus;

Fig. 6 is a table of correspondence between selectable recording modes and the copyright-compliant or copyright-noncompliant memory card that is inserted into the apparatus;

Fig. 7 is a block diagram of a memory recording and reproducing apparatus applicable to a second processing

example of the invention;

Fig. 8 is a flowchart of steps constituting the second processing example performed when the copyright-compliant or copyright-noncompliant memory card is inserted into the memory recording and reproducing apparatus; and

Fig. 9 is a table of correspondence between selectable recording modes and the copyright-compliant or copyright-noncompliant memory card that is inserted into the apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of this invention will now be described. The invention is embodied illustratively as a portable device that utilizes a flash memory-loaded memory card as a detachable storage medium. The portable device is illustratively an apparatus for recording and reproducing digital audio signals and other data. This portable device may be called simply recorders hereunder.

The preferred embodiments to be described use one of two types of memory card: a copyright-compliant memory card 40A having a security function for copyright protection, or a copyright-noncompliant memory card 40B having no security function for copyright protection.

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Each of these cards will be described later in detail.

Fig. 1 is a block diagram of a portable device (recorder 1) with the memory card 40A inserted into the recorder as a storage medium.

In Fig. 1, broken lines enclose two major blocks, one block depicting how the recorder 1 is constituted, the other block showing how the memory card 40A is structured. The memory card 40A is loaded into the recorder 1 in a freely detachable manner.

The recorder 1 and the memory card 40A (and 40B, to be described later) constitute a recording and reproducing system. This system is capable of recording and reproducing not only digital audio signals but also moving and still picture data.

The recorder 1 comprises a CPU 2, a security block 3 connected to the CPU 2 through a bus, an operation unit 4, and a display device 5.

The security block 3 includes a DES (Data Encryption Standard) encryption circuit and a circuit for performing an authorization process.

The operation unit 4 has keys, buttons, a jog dial and other controls which allow users to carry out various operations regarding recording and reproduction.

Operation information such as a recording or

playback command generated in response to a user operation on the operation unit 4 is sent to the CPU 2 over the bus.

The display device 5 is illustratively constituted by a liquid crystal display panel. Under control of the CPU 2, the display device 5 displays various items of information and an operation status of the recorder 1.

The recorder 1 is also furnished with a mode switch 18. The mode switch 18 is operated to set one of two modes: a microphone input mode in which dictations such as conference proceedings are recorded through a microphone connected by a user, and a line input mode in which audio signals (i.e., music) supplied as a line input are recorded. The term "line input" refers to a data input effected through a terminal 9 acting as a USB connector (to be described later), or to a data input through an optical cable terminal 10 compatible with digital audio input.

The CPU 2 performs various controls by supplying control signals to different parts of the system over the bus. In addition to its functions for controlling recording and reproducing operations, the CPU 2 has a mode judging function 2a and a card judging function 2b, as shown in Fig. 1.

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The mode judging function 2a judges the operated state of the mode switch 18. Depending on how the mode switch 18 is judged to be operated, the mode judging function 2a sets either the microphone input mode or the line input mode.

The card judging function 2b judges whether the inserted memory card is the copyright-compliant memory card 40A (having the security function) or the copyright-noncompliant card 40B, to be described later.

The recorder 1 further includes an audio data interface and encoder/decoder portion 7 (called the encoder/decoder hereunder).

A structure and operations of the encoder/decoder 7 will be described later in detail with reference to Fig. 4. Disposed between the recorder 1 and an externally furnished device, the encoder/decoder 7 provides an I/O interface of audio signals, various encoding and decoding processes, A/D and D/A conversion, and I/O switching processes.

Terminals 8 through 12 are provided to handle audio signal input and output to and from the recorder 1. The input and output of audio signals through these terminals and the concomitant signal processes are carried out by the encoder/decoder 7.

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The terminal 8 is connected to a microphone and admits a voice signal as a microphone input. Illustratively, the terminal 8 allows the recorder 1 to record conference proceedings and other dictations.

The terminal 9 acts as a USB connector terminal used illustratively to perform digital data communication with an external data processing device such as a personal computer. In this example, compressed data are input from an external personal computer through the terminal 9. the compressed audio data entered through the terminal 9 may be written to the memory card 40A or 40B, as will be described later. Audio data retrieved from the memory card 40A or 40B may be output to an external device such as the personal computer through the terminal 9.

The terminal 10 is an optical cable-compatible terminal through which to input an audio signal in the form of digital data from an external audio output device such as the CD player or MD (mini-disc) player reproducing recordings from their respective media.

The terminal 11 is an optical cable-compatible terminal through which to output an audio signal in the form of digital data from an external audio output device such as the MD (mini-disc) player reproducing recordings

40A incorporating the security block 52 is inserted into the recorder 1, an authorization process is carried out to see if the inserted memory card 40A is an authorized card. If the memory card 40A is judged to be authentic, the security block 3 may then share a session key with the security block 52.

The security blocks 3 and 52 are each equipped with a function for executing a suitable authorization process.

As will be described later in more detail, the memory card 40A is a single-chip IC card that carries a flash memory (nonvolatile memory) 42, a security block 52 including a DES encryption circuit, a communication interface, and registers.

The memory card 40A is loaded into the recorder 1 in a freely detachable fashion. In practice, the recorder 1 is capable of accommodating a memory card without encryption functions, i.e., a memory card 40B (to be described later) having no security block.

When input as described above, the audio data are processed by the encoder/decoder 7 and by the security block 3. The audio data thus processed are sent to the CPU 2.

The CPU 2 communicates data through a memory interface 11 with the memory card 40A fastened to a

recorder 1.

The interrupt signal is generated when the memory card 40A is inserted into the recorder 1. With this embodiment, however, the interrupt signal is sent over the data line DIO whereas the interrupt line INT is grounded and not used.

A serial/parallel and parallel/serial conversion interface block 43 (which may be abbreviated to S/P, P/S, I/F block) provides an interface between the control block 41 on the one hand and the memory interface 11 of the recorder 1 connected to the card by means of a plurality of signal lines on the other hand.

The serial/parallel and parallel/serial conversion interface block 43 converts serial data from the recorder 1 into parallel data and feeds the converted parallel data into the control block 41. The interface block 43 also converts parallel data from the control block 41 into serial data and transfers the converted serial data to the recorder 1.

Furthermore, upon receiving commands and data over the data line DIO, the serial/parallel and parallel/serial conversion interface block 43 separates what is received into two groups: commands and data for ordinary access to the flash memory 42 on the one hand,

are identical in shape and size.

The recorder 1 accommodates one of two types of memory card: the copyright-compliant memory card 40A, or the copyright-noncompliant memory card 40B.

The memory card 40A is used to record and reproduce primarily data requiring copyright protection such as pieces of music. The memory card 40B is employed to record and reproduce data that need not be copyright-protected such as conference proceedings.

Basically, when recording conference proceedings or other dictations (called dictation recording hereunder), the user inserts the memory card 40B into the recorder 1, operates the mode switch 18 to establish the microphone input mode, and performs a recording start operation.

With the recording started, an audio signal is input through the terminal 8 connected to the microphone. The input audio signal is recorded to the memory card 40B.

When recording pieces of music or other data subject to copyright protection (called music recording hereunder), the user inserts the memory card 40A into the recorder 1, operates the mode switch 18 to set the line input mode, and performs a recording start operation. This allows an audio signal such as music to be input through the terminal 9 or 10. The audio signal thus input

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In such cases, it is preferred that the desired data be at least recorded in a way that gives due attention to copyright protection.

To meet the above requirements entails getting the card judging function 2b of the CPU 2 to determine the type of the inserted memory card.

By one method, the card judging function 2b of the recorder 1 checks the status of response upon authorization.

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determines the type of the memory card (as 40A or 40B).

Illustratively, after the CPU 2 (with its card judging function 2b) judges the type of the inserted memory card, with the mode judging function 2a judging the mode selected by the mode switch 18, the CPU 2 causes the encoder/decoder 7 to function accordingly.

How the encoder/decoder 7 is typically structured is described below with reference to Fig. 4.

The terminals 8, 9 and 10 each correspond to a relevant data input stream. The input stream that admits microphone input through the terminal 8 is made up of a microphone amplifier 71, a switch 74, an A/D converter 77, and an ADPCM encoder 76.

An audio signal entered as the microphone input is amplified by the microphone amplifier 71. The amplified signal is transferred through a terminal "c" of the switch 74 to the A/D converter 77 for conversion into digital data. After the conversion, the digital data are subject to ADPCM compression by the ADPCM encoder 76. The audio signal compressed through ADPCM is fed to the security block 3 via a terminal "a" of a switch 75.

Usually, the microphone input audio signal is recorded to the memory card 40B as described above while being exempt from an encryption process. A switch 3c in

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block 3, the audio signal is encrypted by the encryption block 3a before being sent to the CPU 2.

Input data admitted through the terminal 9 acting as a USB connector include digital audio signals such as pieces of music supplied illustratively from the personal computer as mentioned above. Such digital audio signals have undergone ATRAC3 compression and encryption.

The personal computer carries software that ensures compatibility with the system of the recorder 1. The software allows ATRAC3-compressed and encrypted audio data to be transferred to the recorder 1 for recording to the memory card 40A. This makes it possible illustratively for audio data as desired contents to be copied or relocated with high quality to the memory card.

In that case, there is no need for the encoder/decoder 7 to carry out an ATRAC3 compression process or for the security block 3 to perform an encryption process. Thus the input data through the terminal 9 are fed to the security block 3 via a terminal "b" of the switch 75. The switch 3c in the security block 3 is operated to let the input data bypass the encryption block 3a on their way to the CPU 2.

The input stream associated with the terminal 9 also includes an ATRAC3 decoder 72 and a D/A converter 73.

block 3b or to let the data bypass the decryption block 3b.

In this example, encrypted data held in the memory card 40A have been encoded through ATRAC3. When reproduced and transferred by the CPU 2, such data are decrypted by the decryption block 3b before being sent to the ATRAC3 decoder 83.

Although shown discretely in Fig. 4, the ATRAC3 decoder 72 and ATRAC decoder 83 may be constituted by an integral component.

The ATRAC3 decoder 83 produces a 16-bit-per-sample audio signal sampled at 44.1 kHz. This audio signal is sent through the switch 80 to the terminal 12 for output as digital audio data.

Alternatively, the 16-bit-per-sample audio signal sampled at 44.1 kHz from the ATRAC3 decoder 83 is fed through the switch 81 to the D/A converter 82 for conversion into an analog audio signal. After the conversion, the analog audio signal is output through the terminal 12 to an external device.

Data held in the memory card 40B have not been encrypted. As will be described later, data to be recorded to the memory card 40A may not be encrypted in some cases. If such encryption-free data are reproduced,

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follows: in step F101 of Fig. 5, the mode judging function 2a of the CPU 2 judges the mode set by operation of the mode switch 18.

If the microphone input mode is judged to be set by the mode switch 18 (i.e., for dictation recording), step F102 is reached in which the CPU 2 connects the switch 74 to its terminal "c" and the switch 75 to its terminal "a." At this point, the switch 3c is operated in the security block 3 for the flow of data to bypass the encryption block 3a.

The switch settings above complete an input stream in which an audio signal picked up by the microphone is moved from the terminal 8 to the CPU 2 after passing through the microphone amplifier 71, A/D converter 77 and ADPCM encoder 76, in that order. The microphone input audio signal is thus recorded in ADPCM mode in step F105. That is, the signal undergoes ADPCM compression but is not subject to encryption before being recorded to the memory card.

In the case above, the memory card 40B should be used as a rule but the memory card 40A may also be employed for dictation recording. That is, data are still recorded even if the user inadvertently inserts the memory card 40A (or intentionally when, say, a memory

card 40B is not on hand).

When the microphone input mode is in effect, the settings of the switches 74 and 75 disable recording of data through the terminal 9. That is, music data requiring copyright protection will not be admitted through the terminal 9 for recording to the inserted memory card in the microphone input mode.

If in step F101 the line input mode is judged to be in effect, i.e., if the user wants recording of music through a data copy or relocation from the personal computer, then the CPU 2 goes to step F103. In step F103, the card judging function 2b judges the type of the inserted memory card.

If the inserted memory card is judged to be the copyright-compliant memory card 40A, step F106 is reached. In step F106, the switch 75 is connected to its terminal "b."

The setting of the switch 75 completes an input stream in which the audio signal entered through the terminal 9 acting as a USB connector (i.e., the signal is made of audio data having undergone ATRAC3 encoding and encryption) is forwarded to the CPU 2. The audio data supplied by the personal computer or the like are thus recorded in ATRAC3 mode in step F107. That is, the audio

data having undergone ATRAC3 encoding and encryption are recorded to the memory card 40A.

When the line input mode is established with a view to copying or moving music data from the personal computer, the user may inadvertently insert the copyright-noncompliant memory card 40B. In that case, attempts to copy or move the data will disable authorization processes between the recorder 1 and the memory card 40B and may sometimes lead to a violation of copyrights. On the other hand, an outright prohibition of data recording will be a disservice to well-meaning users.

The switch settings above complete an input stream in which the audio signal entered through the terminal 9 acting as a USB connector (i.e., the signal is made of audio data having undergone ATRAC3 encoding and encryption) is forwarded to the CPU 2 after passing through the ATRAC3 decoder 72, D/A converter 73, A/D converter 77 and ADPCM encoder 76, in that order.

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involved, BMP (bit map) or HD (High-Definition) may be adopted as the method for high quality compression, and GIF, JPEG or SD (Standard Definition) may be used for low quality compression.

In the configuration example of Fig. 4, the high-quality ATRAC3 signal was shown converted to the low-quality ADPCM signal. Alternatively, the order of the signal conversion may be reversed.

In the processing example above, the quality of recorded data was shown varied by altering the target data compression rate depending on whether the copyright-compliant memory card 40A or copyright-noncompliant memory card 40B is being inserted. In an alternative example, a stereo audio signal may be recorded to the copyright-compliant memory card 40A while a monaural audio signal is recorded to the copyright-noncompliant memory card 40B.

How stereo and monaural audio signals are recorded to the different memory cards will now be described in reference to Figs. 7 through 9.

Fig. 7 depicts a typical structure of the encoder/decoder 7 adapted to the alternative processing example. In Fig. 7, those parts with their functionally identical or equivalent counterparts already shown in Fig.

being sent to the CPU 2, as in the structure of Fig. 4.

Input data admitted through the USB connector terminal 9 include digital audio signals such as pieces of music supplied illustratively from the personal computer as described above. Such digital audio signals have undergone ATRAC3 compression and encryption.

In that case, there is no need for the encoder/decoder 7 to carry out an ATRAC3 compression process or for the security block 3 to perform an encryption process. Thus the input data through the terminal 9 are fed to the security block 3 via a terminal "b" of the switch 93. The switch 3c in the security block 3 is operated to let the input data bypass the encryption block 3a on their way to the CPU 2.

It should be noted that the input stream associated with the terminal 9 also includes a stereo/monaural converter 92.

The ATRAC3-processed digital audio signal entered through the terminal 9 comes with right- and left-channel data alternately multiplexed on a time division basis. The stereo/monaural converter 92 thins out the right- and left-channel data from the time division multiplexed stereo data for conversion into a monaural signal.

Thus as long as the terminal "a" of the switch 93

is connected, monaural audio data are fed to the CPU 2 as the data to be recorded.

A data output stream of the encoder/decoder 7 is made up of an ATRAC3 decoder 83, an ADPCM decoder 79, switches 80 and 81, and a D/A converter 82 as in the structure of Fig. 4.

When audio signals are admitted through the terminal 8 or 9 of the above-described encoder/decoder 7 for recoding to the inserted memory card, the CPU 2 controls the switch 93 in accordance with the established mode and the type of the memory card. Typical steps to control the switch 93 are shown in Fig. 8.

At the time of recording, the CPU 2 first reaches step F201 of Fig. 8. In step F201, the mode judging function 2a of the CPU 2 judges the mode established by operation of the mode switch 18.

If the microphone input mode is judged to be set by the mode switch 18 (i.e., for dictation recording), the CPU 2 reaches step F202 to connect the switch 93 to its terminal "c."

In the security block 3, the switch 3c is operated to have the encryption block 3a bypassed by the flow of data.

The switch settings above complete an input stream

through a data copy or relocation from the personal computer, then the CPU 2 goes to step F204. In step F204, the card judging function 2b judges the type of the inserted memory card.

If the inserted memory card is judged to be the copyright-compliant memory card 40A, step F207 is reached. In step F207, the switch 93 is connected to its terminal "b."

The setting of the switch 93 completes an input stream in which the audio signal entered through the USB connector terminal 9 (i.e., the signal is made of audio data having undergone ATRAC3 encoding and encryption) is forwarded to the CPU 2. The audio data supplied by the personal computer or the like are thus recorded in ATRAC3 mode in step F208. That is, the audio data having undergone ATRAC3 encoding and encryption are recorded to the memory card 40A.

If in step F204 the inserted memory card is judged to be the copyright-noncompliant memory card 40B, the CPU 2 reaches step F205. In step F205, the switch 93 is connected to its terminal "a."

The above setting of the switch 93 completes an input stream in which the audio signal entered through the USB connector terminal 9 (i.e., the signal is made of

terminal 9 is recorded in ATRAC3 stereo mode, i.e., with high quality. If the copyright-noncompliant memory card 40B is judged to be inserted, the USB data transfer input through the terminal 9 is recorded in ATRAC3 monaural mode, i.e., after being converted to lower-quality data.

A digital audio signal entered through the terminal 10 may be arranged to be barred from being recorded if anything other than the memory card 40A is found inserted, e.g., if the presence of the memory card 40B deters authorization or encryption processes.

Alternatively, where the memory card 40B is inserted, the setup indicated by broken lines in Fig. 4 may be used to convert the input data to monaural format for recording to the inserted memory card.

In another alternative, where the copyright-compliant memory card 40A is inserted, the data input through the terminal 9 may be recorded to the card as a stereo audio signal having undergone high-quality compression; where the copyright-noncompliant memory card 40B is inserted, the data may be recorded as a monaural audio signal having undergone low-quality compression.

Although specific embodiments have been described above, these should not be construed as limiting the scope of the invention. The invention applies not only to

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portable terminal apparatuses such as recorders for dealing with music, voice and other audio data, but also to portable terminal apparatuses which handle text data, moving picture data, still picture data, and computer-ready data (programs, files, etc.).

Illustratively with regard to copyright protection, text data fall into two categories: published text data subject to copyright protection, and privately created text data such as typed sentences or diaries that are not subject to copyright protection.

Text data subject to copyright protection need to be recorded or reproduced by a security block-equipped system such as the one made up of the recorder 1 and memory card 40A described above. Text data not subject to copyright protection requirements should be recorded or reproduced by a system without a security block such as the one constituted by the recorder 1 and memory card 40B above. The invention may also be practiced as a portable terminal apparatus dealing with these kinds of text data.

This invention also applies in like manner to moving picture data, still picture data, computer-ready data and others.

In the embodiments above, nonvolatile memories exemplified by the flash memory were shown to be used as

quality for copyright protection while avoiding confusion or inconveniences such as mistaking inoperativeness for a system defect or an outright mechanical failure to record the necessary data.

When loaded with a copyright-compliant memory, another portable terminal apparatus according to the invention causes the memory to record an input digital audio signal (line input signal) subjected to the first compression process; when furnished with a copyright-noncompliant memory, the inventive portable terminal apparatus causes the memory to record an audio signal having undergone the second compression process ensuring the lowered data quality than the first process. The portable terminal apparatus also subjects a microphone input signal to the second compression process before recording the signal to the memory. The arrangements make it possible to eliminate users' inconveniences caused by inadvertent insertion of the wrong memory card while protecting copyrights. This portable terminal apparatus is used advantageously to record microphone inputs that may be stored regardless of the type of the inserted memory.

When loaded with a copyright-compliant memory, yet another portable terminal apparatus according to the

invention causes the memory to record an input stereo signal having undergone the first compression process; when furnished with a copyright-noncompliant memory, the inventive portable terminal apparatus converts the stereo signal to a monaural signal (i.e., corrupts the line input signal in quality) before recording the signal to the memory. The arrangements thus make it possible to eliminate users' inconveniences caused by inadvertent insertion of the inappropriate memory card while protecting copyrights.

Where line input mode is in effect, a further portable terminal apparatus according to the invention and loaded with a copyright-compliant memory causes the memory to record an input digital audio signal (i.e., line input stereo signal) unmodified. When furnished with a copyright-noncompliant memory, the inventive portable terminal apparatus converts the input digital audio signal into a monaural signal before recording the signal to the memory. Where microphone input mode is in effect, microphone input signal is recorded in the memory. The arrangements thus make it possible to eliminate users' inconveniences caused by inadvertent insertion of the inappropriate memory card while protecting copyrights. In addition, this portable terminal apparatus is also used

advantageously to record microphone inputs that may be stored regardless of the type of the inserted memory.

As many apparently different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

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